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An Empirical Analysis of Stock Price Risk in Chinese Growth Enterprises Market - A GARCH-VaR Approach

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Abstract

The aim of Growth Enterprises Market (GEM) is to provide financing channels to burgeoning and high-technology companies which cannot be listed in the main board. GEM is a supplement to the main board. As an emerging securities market, GEM shows a unique volatility compared with the main board. The volatility of GEM has connections and differences with the main board market. Studying the price volatility of GEM contributes directly to the healthy growth of GEM and the main board.

This paper investigates the risk characteristics of GEM and provides several measures to deal with the risk. In this paper, VaR based on GARCH model is utilized for empirical tests. Therefore, this paper studies the characteristics and the extent of volatility risk of GEM stock price systematically.

Keywords: Growth Enterprises Market, Volatility, GARCH, VaR

1. Introduction

Growth Enterprises Market (GEM), designed for burgeoning and high-technology companies which cannot be listed in the main board, provides financing opportunity to target companies. GEM is a supplement to the main board. The supervision of GEM is stricter than the main board. Moreover, supervision department adopts sponsor system to help investors choose a high quality company. On February 8th, 1971, National Association of Securities Dealers Automated Quotations (NASDAQ) was established by National Association of Securities Dealers to standard over-the-counter's chaos and provide financing channel to Small and Medium Enterprises(SMEs). The main characteristic of NASDAQ is to collect and issue unlisted company stocks price over-the-counter. NASDAQ is the second largest securities market in the world after the New York Stock Exchange. There are currently total of 5,400 listed companies in total.

NASDAQ global stock markets adopt electronic trading firstly. Each stock code corresponds to specific listed securities. To facilitate computer recognition, securities code cannot be changed after it is assigned, which facilitate convenient utilization of this system. Compared with GEM in other region, NASDAQ has its own characteristics:

1. Double Track: The NASDAQ national market and small capital markets have two different sets of standard system to deal with different types of companies listing requirements. Usually, in the national market trading company is a certain scale of the company. However, entity traded in the small capital market is smaller emerging companies, because the requirement of small capital market is relative lower than the national market. The securities and exchange commission requires the same scope of regulation towards two markets.
2. Trading Systems: NASDAQ market's technology has a strong power. It uses efficient "Electronic Communication Networks" (ECNs). It installs five million computer terminals which cover the main parts of the globe to send more than five thousand kinds of comprehensive quotation securities and the latest trade information to all corners of the world of dealers, fund managers and brokers. However, these terminals cannot be directly used for securities trading. The use of computerized trading system reduces operating costs, improve efficiency and increase the openness, liquidity, and the effectiveness of the market.
3. Market Maker. NASDAQ has its own market maker system. These people are independent investors taking on a certain stock of buying and selling.
4. Transaction Report. Make people report to the national association of securities dealers' authorities every complete transaction in the market. It must be done within 90 seconds after a deal.

In the 1990s, due to the rise of knowledge economy, a large number of high and new technology enterprises emerged in China. These entities have an enormous financing needs. However, due to the facts that the scale of enterprise itself is not enough to be listed on the main board market, thus promoting the development of the GEM. If GEM only has capital demand without suppliers that the GEM is not likely to get rapid development. Coincided with the will, the fast development of venture capital industry produced a huge demand for investment. It is for emerging stock market in a shot in the arm. The development of the growth enterprise market in China is to provide a more convenient financing channels for small and medium-sized enterprises, creating a normal exit mechanism for venture capital. At the same time, it is also China's important means of adjusting industrial structure and promoting the reform of the economic. The ability to bear the risk is not the same with towards board market and the mainboard market investment

objects. Because of their inherent connection, it will promote the further development of the main board market. The risk of enterprise market is much higher than that of the motherboard market. Besides, return may also be higher. GEM provides a normal exit mechanism for venture capital, promoting risk investment for the project of passion, increasing the efficiency of funds. It turns the technology innovation into economic benefits, stimulating creative passion, mitigating financing difficult problem of small and medium-sized enterprise. Through this channel, China provides more convenient financing of small and medium-sized enterprises and supports healthy and rapid development of small and medium-sized enterprises. Due to the characteristics of the growth enterprise market, the growth enterprise market is volatile and the overall performance is not stable. A great deal of literature pertains to GEM. Most existing literature is about the GEM system of laws, regulations and other theoretical discussion of developed countries. Using the model of quantitative analysis of the GEM risk and volatility is of practical significance.

The remaining part of this paper is organized as follows. Section 2 reviews related literatures. Section 3 introduces the data. Section 4 uses GARCH model to make empirical research towards Shenzhen GEM and NASDAQ market respectively. Section 5 concludes and provides policy recommendations.

2. Related Literature

A large number of papers study the GEM System. Arcot (2007) finds several reasons that make GEM succeed through a detailed analysis of the London Stock Exchange information and data. The superior geographical position of the city of London plays an essential role in the successful rise of GEM. Furthermore, it builds special supervision and management system based on the characteristics of SMEs. The Internet has changed dramatically between 2000 and 2001. After the dot com bubble burst, a large number of investors were attracted by AIM. These investors come from various countries in different classes. However, the AIM still maintains the original order to operation and always has a strong vitality and activity. Due to a series of effective systems in the London Stock Exchange, AIM is constantly updating. Lifelong recommender system is one of significant difference between the AIM and London stock exchange main board market. Moreover, Lifelong recommender system has played a vital role in the standardization of listed company.

There are series of papers which investigate GEM volatility. Stock market in China has some problems in the process of development such as high price, high p/e ratio, high raise, *i.e.*, "three highs" phenomenon. Bubble trend has appeared many times, leading to economic instability, threat to the security of the financial system, and errors in the distribution of wealth and

investment and financing decision-making process. These factors increase the volatility of China GEM and the investment risk of investors. Moreover, these factors hinder the development of SMEs healthy and steadiness, and the stable growth of national economy. Weiss (1981) indicates that information asymmetry and adverse selection lead to the failure market and abnormal market equilibrium. At market failure and abnormal market equilibrium, the efficiency of resource allocation is reduced greatly because the market cannot be a fundamental role in the allocation of resources. Investors will get news first if they master information resource. They will trade according to the market advantage to achieve benefit maximization. However, investors who get the information later cannot make rational investment. If investors mostly get the message slower, then most investors are irrational investors. This expectation effect increases the volatility of the stock market and thus leads to the formation of bubbles. Romer (1985) argues that the market trading information cannot be fully reflected in the market because there is no strong efficient market. In the process of information asymmetry and market transactions, public information can be used to explain part of the asset price fluctuations, but cannot explain all of them. Therefore, the inconsistency between price and value will appear in the market. The price is higher than the value, or the price is lower than the value. Finally, the volatility of market turns up. Shleifer and Vishny (1997) proposes to divide bubble into deterministic bubble and random bubble. The change in investor expectation will result in change in stock price. Investors expect the surge in stock prices will further promote the stock prices. Shares will be in a higher yield level bubble due to stochasticity.

There are also numerous papers on information relevance. Lee (2004) studies NASDAQ and the Asian GEM market in view of the problems of the NASDAQ market and the domestic GEM information. The result is that, compared with the NASDAQ the Asian GEM has lagged behind in terms of the return and volatility spillover effect. Additionally, GEM market will be affected by the motherboard market. As a result, there is a certain degree of related information on the NASDAQ market and the Asian GEM market, and the NASDAQ market will have a certain impact on the Asian market. Additionally, GEM market will be affected by similar impact of the domestic main board market.

At present, more and more papers begin to pay attention to the theory of VaR. Wang (2001) systematically introduces the background, theory and method of VaR. Du (2000) shows that the risk management model based on Metric VaR Risk has a good effect on domestic risk management through empirical studies. Zhu and Li (2011) uses a variety kinds of methods of VAR to empirically analyze the volatility risk of the Hang Seng Index in Hong Kong, and uses Back-Test to test the practicality.

3. Data

3.1 Data Description

In the GEM, the change in the GEM stock price index is an effective tool to measure the fluctuation of stock price level. Stock market index is an important quota to measure the overall stock price volatility and trends, which has been extensively used in the analysis of stoke price. In statistics, the daily stock market index can be divided into minimum index, maximum index, closing index and opening index.

This paper aims to calculate the risk level of stock price volatility in the GEM market. The data are gathered from the GEM index formatted and published by the Shenzhen Stock Exchange, and the selected time period is the first official preparation and release of the GEM index from June 1, 2010 to March 31, 2015 when the index closed, resulting in a total of 1,170 observations. Additionally, this paper takes the NASDAQ index which is programmed and published by NASDAQ, a total of 1,217 observations.

Daily closing index is an observed value, represented by P. However, this paper aims to transform the index into yield sequence since the index is a relative price and its price sequence is not balanced. Because the log yield sequence has good statistical characteristics, this paper transforms it into a sequence of log returns and multiply it by 1,000. The formula is:

$$R\_t=1000*\ln (P\_t / P\_(T-1)), \quad (1)$$

where P_t is the t day closing price of Shenzhen GEM or the NASDAQ index, P_(T-1) represent the t-1 period closing price of Shenzhen GEM and NASDAQ index. Figure 1 provides an overview of the log yield data of Shenzhen GEM index.

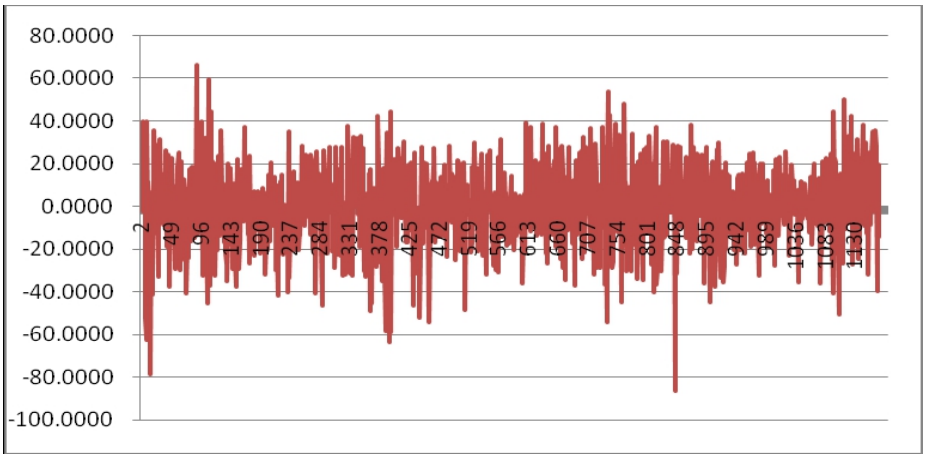


Figure 1 Shenzhen GEM Index Log Return Line Chart

Figure 2 gives a general picture of the log yield data of NASDAQ index.

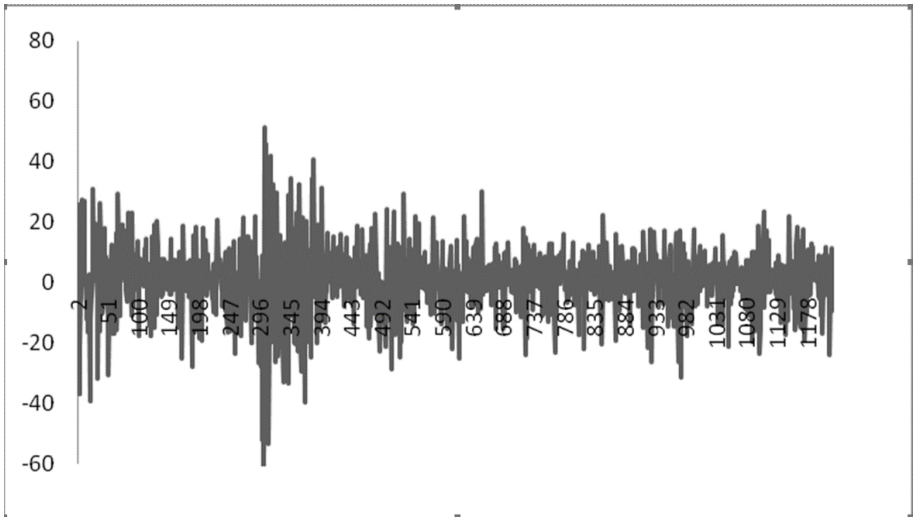


Figure2 NASDAQ Index Log Return Line Chart

Generally, large fluctuations follow large fluctuations, and fluctuations and the steady state of the volatility is an important feature of aggregation. From the two figures above, it can be seen that whether Shenzhen GEM index log return or the NASDAQ index log returns are volatility clustering and volatility of Shenzhen GEM and NASDAQ is quite obvious.

3.2 Data Analysis

3.2.1 Normal Distribution Test

Parameter method is one of the most commonly used methods to calculate VaR. However, to ensure an effective result, the logarithmic yield should follow the normal distribution. Hypothesis test is used to determine whether the sample data of logarithm yield to Shenzhen GEM and NASDAQ index are normal distribution. In this paper, Jarque-Bera test is performed to verify whether the data is normally distributed. J-B statistic is chi-square distribution where the degree of freedom equals to two. J-B statistics judging criteria is the value 9.21 at critical significance level of 1%. If the P value is significantly small, the null hypothesis is rejected. It can be seen that J-B test is based on the size of the P value to determine whether or not the sample data is normally distributed.

The formula of normality test is as follows:

$$JB=(N-n)/6\ [S^2+1/4(K-3)^2], \qquad (2)$$

where N is the sample size, n is the number of estimated coefficients when the sample sequence generated, S is the skewness, and K is the kurtosis. Skewness and kurtosis both are important indicators of volatility among sample data. The skewness is used to measure the degree of asymmetry to the sample time series data. The smaller value of skewness, the more

symmetrical distribution of the time series. The formula is of the following form:

$$S = {}^{1}/_{N} \sum_{i=1}^{n} \left(y_i - {}^{\bar{y}}/_{\sigma} \right)^3. \quad (3)$$

Kurtosis is used to measure the degree of flatness of sample time series distribution. In standard normal distribution kurtosis = 3. If the K value is large than 3, the extent of the distribution of the projections is larger than normal. If kurtosis value is smaller than 3, it indicates that the sequence distribution is flat compared to the normal distribution. Kurtosis K value is calculated as follows:

$$\text{K} = {}^{1}/_{N} \Sigma_{\text{i}=1}^{n} \left(y_i - {}^{\bar{y}}/_{\sigma} \right)^4. \quad (4)$$

Perform J-B normality test on Shenzhen GEM and NASDAQ logarithmic return rate separately. Test results are shown in Figure 3 and Figure 4:

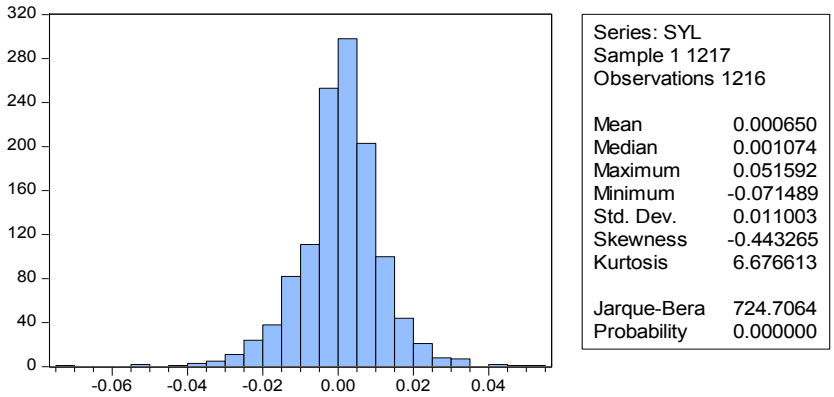


Figure 3 Shenzhen GEM Index Logarithmic Return Series Bar Graph

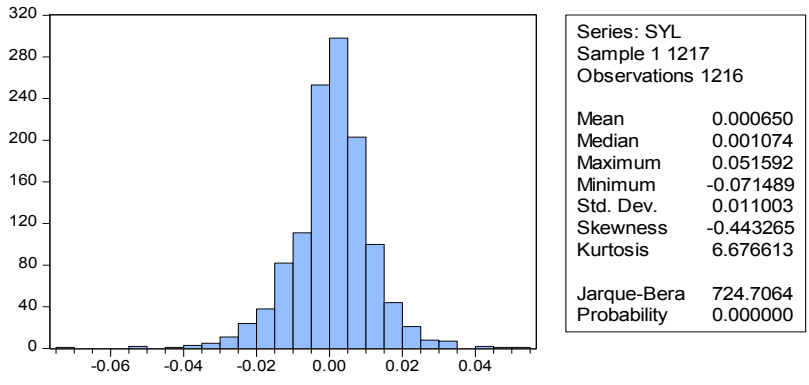


Figure 4 NASDAQ Logarithmic Return Series Bar Graph

The two figures above show that Shenzhen GEM and NASDAQ exhibit normal fat-tail distribution. Financial asset returns exhibit "fat-tail" shape and the mean interval exhibits excessive peak shape. This verifies that the use of GARCH model to fit the GEM volatility is reasonable. The two figures show that logarithmic return series' skewness values in Shenzhen GEM and NASDAQ index are -0.384937 and -0.443265 respectively. Both of them are less than 1 and have a long left tail. Distribution possess the feature of asymmetry and bias to the left, showing that the Shenzhen GEM index and the NASDAQ index sample daily yield less than the average trading day. The Kurtosis of sequences are 3.836726 and 6.676613. Kurtosis is larger than 3, indicating that it exists shark peak compared to standard normal distribution. J-B test results are 724.7064 and 62.97099, greater than the critical value of 9.21 in standard normal distribution, indicating the existence of "fat-tail" feature. The probability of J-B test result is 0, indicating almost impossible events. Therefore, Shenzhen GEM and NASDAQ logarithmic return series are not normal distribution. The normal distribution assumption is not appropriate for the yields of sequences. This paper considers GARCH model to achieve the VaR dynamic estimation.

3.2.2 Stationary Test

Because the VaR is estimated by GARCH model, it should follow some requirements. One of the requirement is that the sample yield sequence must be stationary. Therefore, the stationary of the sample data should be tested before the analysis of GEM return time series. For a given stochastic series, using time series plot to determine whether it is stationary. The basic characteristics of stationary time series is that the value always fluctuates around its average value. Its graphic shows continuously rising or declining features. If the mean and variance of a stochastic process is a constant in the course of time process, and in any two periods the covariance depends only on the distance within that period or lag, and the actual time does not affect the calculation of the covariance, then the time series is stable. Augmented Dickey-Fuller (ADF) test of Shenzhen GEM index result is shown in Table 1:

Table 1 Shenzhen GEM Index Logarithmic Rate of Return Sequence ADF Test

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-25.11056	0
Test critical values：	1%level	-3.435739
	5%level	-2.863807
	10%level	-2.568028

Table 2 shows the ADF test result of NASDAQ index logarithmic return series.

Table 2 NASDAQ Index Logarithmic Rate of Return Sequence ADF Test

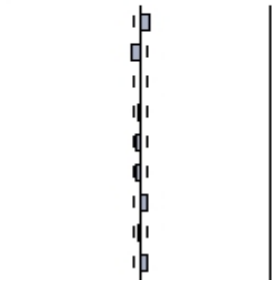
	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-25.11056	0
Test critical values：	1%level	-3.435739
	5%level	-2.863807
	10%level	-2.568028

As shown in Table 1 and Table 2, ADF test results of Shenzhen GEM and NASDAQ index logarithmic rate of return sequences are compared with the corresponding critical value at 1%, 5%, 10%. Shenzhen GEM index logarithmic rate of return sequence ADF test results is equal to -25.11056 which is less than all the corresponding critical value at 1%, 5%, 10%. Therefore, Shenzhen GEM index logarithmic return series is remarkable obviously stationary. Similarly, NASDAQ index logarithmic rate of return sequence ADF test results is equal to -25.11056 which is less than all the corresponding critical value at 1%, 5%, 10%. Therefore, NASDAQ index logarithmic return series is remarkable obviously stationary as well. In summary, the use of GARCH model to calculate VaR through dynamic estimation is appropriate.

3.2.3 Sample Data Autocorrelation Test

The aim of correlation test of Shenzhen GEM and NASDAQ index logarithmic return series is to determine whether they are autocorrelated. Autocorrelation of return series means that changes in time can cause many of the yield distributions to change. The earning in continuous and adjacent periods are not necessarily independent of each other. Therefore, the autocorrelation inspection is necessary before the establishment of the relevant model. Including autocorrelation function (AC) and partial autocorrelation function (PAC) test, AC function can be used to select MA (q) model. The choice is based on the time when the value is equal to 0, j>q. PAC function can be used to select the AR (p) model. The choice is based on the time when the value is equal to 0. The principle of test is based on proper significant level. If the two statistics are larger than the critical value, then it indicates the existence of serial correlation at given significance level. Conversely, if the two statistic is less than the set of critical value, there is no serial correlation. Figure 5 and Figure 6 show the results of autocorrelation.

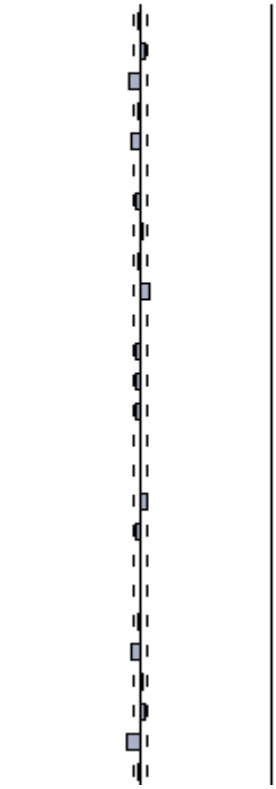
Sample: 1 1170
Included observations: 1169



Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.078	0.078	7.0646	0.008
		2	-0.074	-0.080	13.424	0.001
		3	0.001	0.014	13.425	0.004
		4	-0.010	-0.017	13.546	0.009
		5	-0.029	-0.026	14.525	0.013
		6	-0.040	-0.038	16.381	0.012
		7	0.051	0.054	19.464	0.007
		8	-0.008	-0.023	19.545	0.012
		9	0.046	0.058	22.087	0.009

Figure 5 Shenzhen GEM Index Logarithm Returns Autocorrelation Test

Sample: 1 1217
Included observations: 1216



Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	-0.023	-0.023	0.6641	0.415
		2	0.032	0.032	1.9486	0.377
		3	-0.089	-0.088	11.647	0.009
		4	-0.009	-0.014	11.737	0.019
		5	-0.078	-0.074	19.179	0.002
		6	-0.002	-0.012	19.183	0.004
		7	-0.027	-0.026	20.089	0.005
		8	0.024	0.010	20.790	0.008
		9	-0.021	-0.022	21.316	0.011
		10	0.069	0.058	27.175	0.002
		11	-0.004	0.001	27.195	0.004
		12	-0.026	-0.037	28.046	0.005
		13	-0.029	-0.019	29.104	0.006
		14	-0.027	-0.029	30.012	0.008
		15	-0.005	-0.001	30.044	0.012
		16	-0.003	-0.007	30.054	0.018
		17	0.053	0.047	33.476	0.010
		18	-0.036	-0.042	35.100	0.009
		19	0.002	-0.007	35.104	0.014
		20	0.007	0.012	35.157	0.019
		21	-0.019	-0.028	35.625	0.024
		22	-0.074	-0.068	42.398	0.006
		23	0.012	0.008	42.567	0.008
		24	0.032	0.037	43.875	0.008
		25	-0.103	-0.122	57.053	0.000
		26	-0.015	-0.023	57.321	0.000

Figure 6 NASDAQ Logarithm Returns Autocorrelation Test

Shenzhen GEM and NASDAQ index logarithmic return sequence's autocorrelation function and partial autocorrelation function test results are shown in Figure 5 and Figure 6. Sample's rate of decay is increasing as the time continues. The value of Shenzhen GEM and NASDAQ index logarithmic return sequence's autocorrelation and partial autocorrelation function are almost within the dotted line and its value is significant small. Shenzhen GEM and NASDAQ index logarithmic return sequence are very smooth. This indicates that there is no significant correlation between logarithmic return sequence in Shenzhen GEM and NASDAQ index. Therefore, there is no need to perform autocorrelation correction test.

3.2.4 ARCH Tests

Unconditional distribution of financial time series in practice often have a wider tail than the normal distribution. Time Series exist ARCH effect, which is a necessary condition of GARCH model. ARCH-LM test and residual sum of squares correlation diagram test usually detect a model's residuals whether it contains ARCH effect. In this paper, using ARCH-LM test on Shenzhen GEM and NASDAQ index logarithmic return series. All regression coefficients are zero simultaneously in GARCH model, which is a very important assumption to ARCH-LM test. If a given significance level (e.g. 5%) is less than the probability, the ARCH effect does not exist in time series. In other words, it cannot reject the null hypothesis. ARCH-LM test is generally used for residuals. When people do not know whether residual have ARCH effect, people prefer to use OLS. The best result is the existing of ARCH effect when residual test's Accompanied probability start from stage 1. In other words, probability is significant small from stage 1. Therefore, the null hypothesis will be rejected. However, sometimes the probability of lower order will be relatively large, the null hypothesis will not be rejected. However, the probability of high-order (7-8 order) is small. When the null hypothesis is rejected, it illustrates ARCH effect is strong at the time of high-order. In this paper, the test results of Shenzhen GEM index logarithmic return series are shown in Table 3.

Table 3 Shenzhen GEM Index Logarithmic Rate of Return Series ARCH-LM Test Results

ARCH Test:			
F-statistic	5.271591	Probability	0.0219
Obs*R-squared	5.256854	Probability	0.0219

The test results of NASDAQ index logarithmic return series are shown in Table 4.

Table 4 NASDAQ Index Logarithmic Rate of Return Series ARCH-LM Test

ARCH Test:			
F-statistic	62.66556	Probability	0.0000
Obs*R-squared	59.68310	Probability	0.0000

The autocorrelation test results above show that both autocorrelation coefficients and partial autocorrelation coefficients are significantly different from 0 and Q statistic is very significant. The test results of ARCH effect reveal that statistics accompanied probability is larger than 0.05 when one lag in the time series. R-squared probability is 0.0219 and 0 individually, which are less than the critical value 0.05 obviously. Shenzhen GEM and NASDAQ logarithm returns residuals series have ARCH effect. In summary, the ARCH effect exists in Shenzhen GEM and NASDAQ logarithm returns series. According to the test on sample data, this paper utilizes GARCH (1,1) model. GARCH (1,1) model can fit the Shenzhen GEM and NASDAQ logarithmic return series. To further examine the GARCH (1,1) model's applicability, this paper performs the ARCH test again on (1,1) combination. Therefore, it can accurately determine whether the GARCH (1,1) model is appropriate. Shenzhen GEM and NASDAQ corresponding test results are shown in Table 5 and Table 6.

Table 5 Shenzhen GEM Index Logarithmic Return Series' ARCH test Results

Coefficient	T value	Std. Error	z-statistic	Prob.
Variance Equation				
C	5.91E-06	2.92E-06	2.026684	0.0427
RESID(-1)^2	0.030403	0.008904	3.414367	0.0006
GARCH(-1)	0.951864	0.013780	69.07734	0.0000
R-squared	0.001611	Mean dependent var	0.000749	
Adjusted R-squared	-0.000754	S.D. dependent var	0.018664	
S.E. of regression	0.018671	Akaike info criterion	-5.155212	
Sum squared resid	0.407508	Schwarz criterion	-5.142216	
Log likelihood	3016.221	Durbin-Watson stat	1.839554	

Table 6 NASDAQ Index Logarithmic Return Series' ARCH Test Results

Coefficient				
	t	Std. Error	z-statistic	Prob.
Variance Equation				
C	4.09E-06	1.04E-06	3.941938	0.0001
RESID(-1)^2	0.092495	0.012773	7.241661	0.0000
GARCH(-1)	0.868710	0.017979	48.31742	0.0000
R-squared	-0.003496	Mean dependent var	0.000650	
Adjusted R-squared	-0.002671	S.D. dependent var	0.011003	
S.E. of regression	0.011018	Akaike info criterion	-6.381996	
Sum squared resid	0.147621	Schwarz criterion	-6.369406	
Log likelihood	3883.254	Durbin-Watson stat	2.034475	

As the statistic shown in these two tables, ARCH (l) is on behalf of GARCH model's parameters an and GARCH (l) is on behalf of the model's parameters p. According to the principle of a + p <1, the Shenzhen GEM has the following relation ARCH(l) + GARCH(l) = 0.030403 + 0.951864 = 0.98226 < 1. Similarly, the NASDAQ has the following relation ARCH(l) + GARCH(l) = 0.092495 + 0.868710 = 0.961205 < 1. Both of them satisfy the constraints. Moreover, the Shenzhen GEM and NASDAQ's AIC is -5.155212 and -6.381996 individually and SC is -5.142216 and -6.369406 respectively. These four values are relatively small, so GARCH (1, l) model fit the data well. Performs ARCH-LM test on 3-period-lagged residual series of GARCH (1,1) and the test results are shown in Table 7 and Table 8.

Table 7 Shenzhen GEM Index Logarithmic Return Series GARCH (1,1) Model

ARCH Test:			
F-statistic	0.435960	Probability	0.7273
Obs*R-squared	1.310907	Probability	0.7265

Table 8 NASDAQ Logarithmic Return Series GARCH (1,1) Model

ARCH Test:			
F-statistic	0.883497	Probability	0.5635
Obs*R-squared	10.62312	Probability	0.5615

The aim of ARCH tests is to check whether it eliminate the ARCH effect of the original residuals by checking and confirming the applicability and fitting effect of GARCH Model. The results above show that the Probability F test is 0.7273 and 0.5635 for Shenzhen GEM and NASDAQ logarithmic return series respectively. Both of them are greater than significant level 0.05 and fail to reject the null hypothesis, indicating that there is no ARCH effect in residual series. It means that using GARCH (1,1) model eliminates the ARCH effect of residual serial. In summary, the risk of GEM market can be measured by GARCH model accurately. At this point, GARCH (1,1) model is built.

$$GARCH = C(1) + C(2)*RESID(-1)^2 + C(3)*GARCH(-1). \quad (5)$$

4. Empirical Tests

4.1 Calculating VaR

Through estimation of GARCH (1,1) model above, σ_t can be easily calculated by extraction of a root.

$$\sigma t = C1 + C2 * RESID - 12 + C3 * GARCH(-1). \quad (6)$$

VaR can be determined by the certain confidence level. VaR-GARCH risk assessment formula is as follows:

$$VaR = w_{t-1}\sigma_t z_\alpha \sqrt{\Delta t}, \quad (7)$$

where w_{t-1} the asset value at prior day. In this paper, this refer to the stock price index of the prior day, σ_t is standard deviation of return series, z_α is the quantile confidence level α corresponding to standard normal distribution, and Δt is holding interval, in this paper, one day's VaR is calculated. So Δt=1.

The following statistics table is a normal confidence level corresponding critical value.

Table 9 Corresponding Normal Confidence Level Threshold

C	90%	95%	99%
Z_α	1.65	1.96	2.33

Because it is VaR series based on a dynamic model of GARCH, there are plenty of value. This paper only lists some basic statistical information on Shenzhen GEM and NASDAQ index logarithmic return series' VaR in Table 10 and Table 11.

Table 10 Shenzhen GEM Index Logarithmic Return Series VaR Statistics:

Type and distribution	Mean	Min	Max	Std
GARCH-N (90% confidence interval)	54.96208	29.23161	133.1137	15.05936
GARCH-N (95% confidence interval)	65.28829	34.72361	158.1229	17.88869
GARCH-N (99% confidence interval)	77.61313	41.27858	187.9726	21.26564

Table 11 NASDAQ Logarithmic Return Series VaR Statistics:

Type and distribution	Mean	Min	Max	Std
GARCH-N (90% confidence interval)	32.64633	15.31258	78.72267	10.59602
GARCH-N (95% confidence interval)	38.77988	18.18948	93.51299	12.58679
GARCH-N (99% confidence interval)	46.10057	21.62321	111.1660	14.96287

4.2 Results Interpretation

Normality test results show that both Shenzhen GEM and NASDAQ index logarithmic return series are non-symmetrical and they do not follow a standard normal distribution. GEM yields exhibit the distribution characteristics of shark peak and fat-tail. Distribution tend to be skewed to the right. This distribution has a high degree of projection than normal distribution.

Stationary test illustrates that Shenzhen GEM index logarithmic rate of return sequence ADF test results is equal to -25.11056 which is less than all the corresponding critical value at 1%, 5%, 10%. Therefore, it can be determined that Shenzhen GEM index logarithmic return series is remarkable obviously stationary.

Correlation test results show that there is no significant correlation between logarithmic return sequence in Shenzhen GEM and NASDAQ index. Therefore, there is no need to perform autocorrelation correction test.

ARCH effect test results illustrate that the ARCH effect exists in Shenzhen GEM and NASDAQ logarithm returns series. According to the test on sample data, this paper utilizes GARCH (1,1) model to calculate VaR.

The Line graphs of Shenzhen GEM and NASDAQ index logarithmic return series show that there are significant fluctuations at the initial stage of board market in both Shenzhen GEM and NASDAQ. One of the most important reason is that companies listed in Shenzhen GEM and NASDAQ often focus on the financing instead of bringing a corresponding high rate of return at both of board market initial stage. Performance of the company is not stable. These stocks have high price-earnings ratio and high stock price characteristics, but the high growth disappears. From the VaR statistic calculation above, VaR value of Shenzhen GEM index logarithmic return series are higher than that of the VaR of NASDAQ market as a whole. In addition, the mean of VaR is about 34 towards logarithmic return series on the Shanghai index VaR at 95% confidence level. The Shenzhen GEM and NASDAQ logarithmic return series at the same level of confidence have VaR mean 65.28829 and 38.77988 respectively, both of them are greater than 34. This is because the number of stocks in the board market are large enough. According to inspection and verification by the foregoing results, using of GARCH model on Shenzhen GEM and NASDAQ logarithmic return series to measure VaR is an effective way.

5. Conclusion and Policy Suggestion

The universal characteristic of GEM listed companies is of high risk but high return. The overall performance of Chinese GEM is not stable, and the market volatility is evident. The degree of fluctuations in the period after the opening of 2010 is very severe according to the volatility of the yield and it tends to be slow, but the overall volatility is still large. The GEM itself has three characteristics: high issue price, high price earnings ratio and high yield. However, the GEM has low barrier so that the GEM market may exist a lot of moral hazard problems caused by information asymmetry and there may be a lot of bad companies in the GEM rushed through the hidden information as high quality enterprises causing the mass.

In response to these circumstances, learning from the management experience NASDAQ, and combining with the actual situation of Chinese GEM, this paper puts forward the following policy suggestion.

5.1 Reasonable Orientation

One of the important reasons for the failure of international GEM is that there is no accurate orientation. If the level of the orientation is too high, in other words, the barrier of GEM market is too high, there will be different characteristics with the GEM which should have a low barrier. The key is that high threshold will lead to a lot of potential business losing the financing opportunities in the GEM market, resulting in the cash flow of those potential enterprise in trouble, facing with the development bottleneck, and

even leading to these potential enterprises to fail. If positioning is too low, *i.e.*, any companies can enter the GEM market, it will cause great moral hazard problem. Some irresponsible companies will be listed actively and they will seek for funds, which not only will cause the risk for the overall GEM, but also will lead to the crowding-out effect, resulting in the fact that better-performed companies cannot get financing investment or the increasing in cost of investment, which will be the destructive damage for GEM market. So the premise of the healthy operation of the GEM market is reasonable positioning. The purpose of the establishment of the GEM market is to support SMEs, which is the ultimate cause of the rise of the GEM. This market positioning should always be carried out in the creation of the GEM, and in the future operation of the GEM. The development of Chinese economy is influenced by the SMEs, and the financing development of SMEs financing is decided by whether it can always be carried out. The GEM is used to support the development of SMEs under this market positioning. The sustainable and healthy development of Chinese economy is determined by the development of SMEs. Therefore, the development of GEM is helpful to the development of our country's economy.

GEM market should be coordinated with the development of the main-board market, and the establishment of the GEM will inevitably affect the motherboard market, for example, it will cause a lot of loss in investment, which will greatly reduce the supply of funds in the motherboard market, causing the overall decline in the price of the stock. However, it is a short-term influence. In the long term, because the GEM and the main board market have their own characteristics, more companies and investors are to enter the securities market, improving the efficiency of social resources which is beneficial to make an inventory of the stock and improving the speed of economic development in China.

5.2 Improving the Construction of GEM Market System

One reason of the radical volatility of the GEM market is that the quality of the GEM market is a motley crowd. There exists a large quantity of 'parallel' companies which are short of technology, development potential and profit growth rate. This kind of company always has a bad performance. They tend to have a negative influence on the higher price earnings ratio. Those companies seriously affect the reputation and quality of the GEM market. If the securities are to enter the market conducting transactions, the first step is to issue stock which is the bond to connect the issuing market and circulation market. The most important and basic systems is IPO system, because the premise and condition of the constant development and expansion of the stock market is issuing and listing.

The current Chinese issuing system is an authorized system. Authorized system is a kind of transitional issuance and approval system. The examination elements of issuance do not only contain the reliability of submitted materials, but also include the profit ability and development ability. However, registration system is only responsible for reviewing the authenticity of the materials submitted and require the applicant to provide all information concerning the internal and issuing of the enterprise, but it does not require the implementation of substantive verification. Only the authenticity of the information is to be audited, as long as the conditions are relevant, companies can be listed in the market issue.

At present, China is still in the early stage of the establishment of the GEM. Imperfect capital market and irregular laws and regulations impel the government to continue using the current authorized system. However, when the market matures, the registration system should be selected to test the stock market system since the registration system can improve the risk awareness of investors and makes it easier for companies to list, which will result in the increase of the quantity of listed enterprises. The supply of funds is limited, which will promote the survival of the fittest and increase the efficiency of the use of funds. What is the most important is that the registration system can stimulate the enthusiasm of investors' needs to find projects and promote the formation of the project listed impulse, accelerating the process of project financing. It is also conducive to China's national innovation, the implementation of the policy of people to start a business.

As for the GEM listing standards, this paper argues that the NASDAQ market achievements of the GEM market experience can be commended. The NASDAQ market is divided into the NASDAQ global select market, the NASDAQ global market, the NASDAQ capital market. Different markets have different listing standards to meet the diversified needs of enterprises listed and different risk preferences of investors with different investment needs. China's GEM market has just started, so the number of companies listed on the GEM is small. If the GEM market is further segmented, then it will lead to each section of the volatility to increases, and the risk will also increase.

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